

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

THE LIP-FERNS OF THE SOUTHWESTERN UNITED
STATES RELATED TO CHEILANTHES
MYRIOPHYLLA.*

BY WILLIAM R. MAXON.

Under the names *Cheilanthes myriophylla* Desv., *C. Clevelandii* D. C. Eaton, and *C. Fendleri* Hook., but chiefly under the first, there have been associated in herbaria for many years several species whose distinctive characters have been so little observed or correlated that identical material has been variously labelled and the whole complex has been regarded either as hopelessly confused or as representing two or three species of inordinate variation. An extreme view of the situation was given definite expression by D. C. Eaton, who wrote in the Botany of the Death Valley Expedition as follows:

“I find it impossible to distinguish between *C. myriophylla* and *C. Fendleri*. Specimens which I had at one time called *C. Fendleri* I afterwards referred to *C. myriophylla*, and Mr. Davenport again placed in *C. Fendleri*. Even Mr. Faxon's carefully drawn figures in the Ferns of North America (t. lxxix) do not show the differences which I thought I could discern when that book was written, and I am persuaded that *C. myriophylla* is a fern which represents a multitude of varying forms, connected by all degrees of intermediate conditions, which it is not worth while to try to separate, even into named varieties.”†

Others, who have been familiar with one or more of the forms in the field and have noted their peculiar characters, have

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† Contr. U. S. Nat. Herb. 4: 227. 1893.

tacitly doubted the correctness of this conclusion, but there has been no critical study of the group as a whole. In particular, the common plant of southern California, passing for the most part as *C. myriophylla*, has long been known to depart widely from current descriptions of this species. More recently this discrepancy has again been brought to the writer's attention by Mr. George L. Moxley, and by several other California botanists quite independently, and the present paper has resulted from an effort to clear up the existing confusion in the whole series of related or misidentified forms occurring in the southwestern states. The conclusions reached are altogether at variance from Eaton's judgment above quoted, but are in the main satisfactory and appear to be fully substantiated by the great amount of herbarium material now available.

The facts appear to be, briefly, that *C. myriophylla*, an andine species of North and South America, does not extend north of Mexico and must be excluded from the United States flora; that *C. villosa* Davenp., of the Mexican Border region, is a nearly related but well defined species; that the plant of southern California and adjacent territory represents a variable undescribed species (*C. Covillei*), including a northern, mainly coastal form which further study and material may show to be specifically distinct; and that the southwestern plants referred mostly to *C. Fendleri* actually pertain to two species, *C. Fendleri* and an undescribed species (*C. Wootoni*), similar in general habit but easily recognizable upon characters of the scaly covering of the under surface.

The distinguishing characters of these species and of *C. Clevelandii*, which has sometimes been confused with *C. Covillei*, are given in the accompanying descriptions and key. For the purposes of the present paper it is not necessary to deal critically with *C. myriophylla*, which, excluding the United States plants heretofore so referred, is taken in its traditional sense. Thus restricted, *C. myriophylla* is still a variable species, possibly comprising several forms worthy of separation. The tropical material at hand is ample and will serve as the basis of a later paper. Its segregation does not affect the status of species occurring within the United States.

Rhizome decumbent to suberect, massive, nodose or multicapital, with tufted scales; upper surface of the segments of the lamina hairy, devoid of scales.

Stipes densely clothed with very slender appressed scales; segments of the lamina bearing a few weak, tortuous, moniliform hairs above, these lightly attached. . . . 1. *C. myriophylla.*

Stipes bearing numerous large, oblong, whitish, spreading scales, in addition to the linear to filiform, appressed or ascending scales characteristic of the group; segments of the lamina rather densely villous above, the hairs coarse, widely curved and flexuous, tortuous, distantly and obscurely septate, persistent. 2. *C. villosa.*

Rhizome creeping (usually widely so), with few to numerous short, mostly slender branches, the scales imbricate, closely appressed to loosely secund; upper surface of the segments devoid of hairs, in no. 5a bearing a few minute, pale, subpersistent, stellate scales.

Scales of the under side of the lamina nonciliate, oblique, loosely imbricate, not always covering the segments. . 3. *C. Fendleri.*

Scales of the under side of the lamina invariably long-ciliate (at least in the basal part), widely imbricate, wholly covering the segments.

Rhizome deciduously paleaceous, the scales relatively broad, acutish to long-acuminate, membranaceous, usually pale brown and concolorous, the middle portion never strongly sclerotic; scales of the lamina beneath firmly attached at the subcordate to cordate base.

4. *C. Wootoni.*

Rhizome persistently paleaceous, the scales linear to lance-attenuate, rigid, bright brown to blackish, strongly sclerotic throughout or toward their apex; scales of the lamina beneath lightly attached above the closed sinus of the deeply cordate base, the lobes overlapping.

Fronds many, closely placed upon the numerous short, sometimes thickish branches of the rhizome, these often close and intricate; segments roundish or irregularly oval.

Segments devoid of scales above; scales of the lamina beneath whitish to pale castaneous, large, much exceeding the segments. 5. *C. Covillei.*

Segments bearing a few minute, pale, stellate scales above; scales of the lamina beneath bright castaneous to cinnamomeous, narrower, more numerous, mostly not exceeding the segments, many of them minute, very copiously ciliate, entangled, forming a loose tomentum.

5a. *C. Covillei intertexta.*

FronDS few, larger, with stouter, lighter-colored stipes, spaced (5-10 mm. apart), the rhizome relatively more slender, with a few short, slender branches; segments of the lamina prevailingly subcordate-orbicular. 6. *C. Clevelandii*.

1. *Cheilanthes myriophylla* Desv. Ges. Naturf. Freund. Berlin Mag. **5**: 328. 1811.

Cheilanthes elegans Desv. Ges. Naturf. Freund. Berlin Mag. **5**: 328. 1811.

Cheilanthes paleacea Mart. & Gal. Nouv. Mém. Acad. Sci. Brux. **15**: 76. pl. 21, f. 2. 1842.

Viewed in the sense above mentioned, *Cheilanthes myriophylla* is a variable species occurring rather commonly in mountain regions from Argentina and Bolivia to northern Mexico. The numerous specimens from these regions show general agreement in the following characters:

Rhizome massive, decumbent or suberect, usually multicapital, the divisions short, nodose; fronds closely fasciculate, tall, stiffly erect; stipes very densely appressed-paleaceous, the scales exceedingly numerous, very narrow, conform, persistent, closely investing the stipe: lamina 3-4-pinnate, densely paleaceous beneath, the scales variable, the larger ones of an ovate type, very firmly attached at the elevated, deeply cordate base, acuminate to attenuate at the apex, nonciliate, subentire to strongly erose-dentate; numerous reduced scales of the under surface and rachises tortuous, filiform, recurved among the segments and partially overlying their upper surface; segments minute, beadlike, sessile or short-stalked, bearing a few tortuous, weak, moniliform hairs above, these lightly attached, readily abraded; sporangia borne well within the deeply concave or cucullate rounded outer border of the segment, the broad margin commonly bilobed and crenate, with paler and thinner edges. Leaf tissue dull green, herbaceous.

These characters denote a close relationship with *C. villosa* only, with which species it is contrasted in the key. The original specimens of *C. myriophylla* are said by Desvaux to have come from South America, the particular region not being indicated.

2. *Cheilanthes villosa* Davenp. Cat. Davenp. Herb. Suppl. 45. 1883.

Rhizome ascending or decumbent, massive (1-3 cm. in diameter), nodose or multicapital, the few branches close, short, and thick (5-10 mm. in diameter), coarsely radice, densely paleaceous, the scales tufted (especially at the apices), narrowly subulate-attenuate, 5-9 mm. long, 0.5 mm. broad or less at the base, strongly falcate, flexuous in the apical half, with a narrow, opaque, strongly sclerotic, dark brown median band nearly throughout, the delicate translucent whitish borders with a few distant, low, minute, rounded teeth. Fronds numerous, erect, dorsal, fasciculate (often appearing subcespitose), 10-33 cm. long; stipe 4-14 cm. long, 0.7-1.5 mm. in diameter, subflexuous, purplish brown, with a nearly persistent covering of minute, appressed, linear scales and numerous large, oblong, white or pale tawny, spreading scales; lamina

linear-oblong or narrowly oblong-lanceolate, acuminate, 6-23 cm. long, 2-5 cm. broad, tripinnate, the larger tertiary segments ternately (rarely pinnately) divided; rachis similar to the stipe, copiously paleaceous; pinnae numerous, mostly alternate, adjacent (or several lower pairs distant), ascending, upwardly falcate and involute in drying, mostly deltoid-oblong, the lower and especially the basal ones rather broadly deltoid and strongly inequilateral; secondary and tertiary rachises copiously paleaceous beneath, the scales very large, nearly covering the pinnae, whitish or pale tawny with a darker base, ovate, acuminate to long-acuminate, attached at the cordate base (the sinus commonly closed, with overlapping lobes), erose-denticulate, translucent, the cells very irregular, with deeply sinuous partition walls; tertiary segments simple and spatulate to cuneate-obvate, or the larger ones mostly divided into 3 segments, the terminal one larger and more strongly cuneate; ultimate segments in general minute, beadlike, close, glabrous beneath, rather densely villous above, the hairs very coarse, flattish, curved and somewhat flexuous, tortuous, yellowish-hyaline, distantly and obscurely septate; sporangia few, borne within the deeply recurved or cucullate, bilobed border of the segment above the cuneate base, the slightly modified margin a little thinner and paler. Leaf tissue grayish green, herbaceous, minutely papillose, wrinkled in drying.

This rare and strongly marked plant was first brought to notice by Davenport, who recognized its relationship to *C. myriophylla* and regarded it as a "provisional new species," basing his exceedingly brief and rather misleading description upon specimens collected in southeastern Arizona by Lemmon in September, 1881. Through the kindness of Mr. William P. Rich, Custodian of the Davenport Herbarium of the Massachusetts Horticultural Society, the writer has been able to examine a portion of the type specimen. This agrees closely in all particulars with specimens collected on limestone ledges in the Santa Rita Mountains of Arizona, by C. G. Pringle, May 14, 1884, and widely distributed among herbaria as "*Cheilanthes myriophylla* Desv. (True!)." The agreement is, in fact, so complete that for all practical purposes the latter, generally available collection may be regarded as equivalent to the type.

In its stout, ascending or decumbent rhizome, very long, slender, strongly sclerotic rhizome scales, and conspicuously villous upper leaf surfaces *C. villosa* differs markedly from *C. Fendleri* and *C. Wootoni*, and, except for the sclerotic character of its more elongate rhizome scales, equally from *C. Covillei*. In most respects it is much nearer *C. myriophylla*, but from that it differs strongly in the points stated in the key.

The following specimens of *Cheilanthes villosa* are in the National Herbarium.

ARIZONA: Conservatory Canyon, Huachuca Mountains, Aug., 1882, *Lemmon*; Santa Rita Mountains, on limestone ledges, May 14, 1884, *Pringle* (labelled *C. myriophylla*, "True!" 4 sheets).

NEW MEXICO: Hanover Mountain, Grant County, Aug. 9, 1911,

Holzinger; Big Hatchet Mountains, Grant County, *Mearns* 224; North Percha Creek, south end of Black Range, alt. 1800 meters, on limestone, *Metcalf* 952; Bishop's Cap, Organ Mountains, Oct. 21, 1906, *Wootton & Standley*.

TEXAS: El Paso, *Mearns* 231, *Stearns* 215; near Sierra Blanca, *Rose, Standley & Russell* 1223Sa.

MEXICO: Santa Eulalia Mountains, Chihuahua, July 30, 1885, *Wilkinson*; Sierra Mojada, Coahuila, *Jones* 532.

3. *Cheilanthes Fendleri* Hook. Sp. Fil. 2: 103. pl. 107. B. 1852.

Rhizome epigeal, wide-creeping (5-12 cm.), slender (1-2 mm. in diameter), simple or with a few, usually short branches, terete, often flexuous, light brown, subpersistently paleaceous, the scales loosely imbricate, secund, narrowly ovate, long-acuminate to attenuate, 2-2.5 mm. long, 0.6-0.8 mm. broad, straight or falcate, entire, membranaceous, translucent, very pale brown, concolorous or nearly so. Fronds several, erect, distichous, evenly spaced about 1 cm. apart or often subfasciculate at the ends of the branches, 8-30 cm. long; stipe 0.4-1.2 mm. in diameter, 3-18 cm. long, somewhat flexuous above the arcuate base, brownish-castaneous, sublustrous, persistently paleaceous, the numerous scales pale, linear-attenuate to filiform, mostly small, ascending or subappressed; lamina narrowly oblong-lanceolate to ovate-lanceolate, acuminate, 5-14 cm. long, 2-3.5 cm. broad, tripinnate, the tertiary segments simple to ternately cleft or divided; rachis similar to the stipe; pinnae contiguous to distant, mostly alternate, oblique, subarcuate, for the most part narrowly oblong to elongate-triangular and acuminate, the largest ones more broadly triangular or sometimes ovate-triangular, strongly inequilateral (broader below); secondary and principal tertiary rachises bearing numerous spreading loosely imbricate scales beneath, these relatively large, variable in number and disposition, usually exceeding the segments, partially or sometimes wholly concealing them, tawny to light reddish brown, paler toward the margin, oblique, firmly and rather broadly attached at the rounded or subcordate base, ovate and long-acuminate to ovate-lanceolate and long-attenuate, denticulate, not at all ciliate, the cells irregularly elongate, with sinuous partition walls; segments close or usually distant, mostly oblique, broadly rounded-obovate to cuneiform, the terminal ones the largest, these strongly cuneate and obliquely cleft, the largest basal ones also sometimes 2-3-cleft or divided; sporangia few, large, borne within the strongly recurved apical border of the segments or its lobes, the margin slightly modified. Leaf tissue rigidly herbaceous, bright green, minutely papillose, glistening.

Cheilanthes Fendleri was founded on specimens collected "somewhere about Santa Fe,"* New Mexico, in 1847, by A. Fendler (no. 1015). The original collection is missing from the National Herbarium; but of the two closely related species of the Mexican Border region heretofore confused under this name the description points rather plainly to the plant with nonciliate scales, and as the Gray Herbarium specimen agrees,

* Standley, Contr. U. S. Nat. Herb. 13: 175. 1910.

it seems safe to apply the name in this sense. The plant with ciliate scales is regarded as a new species, *C. Wootoni*.

The differences distinguishing *C. Fendleri* and *C. Wootoni* are stated in the key, and are further mentioned under the latter species. The ranges of the two overlap, but *C. Fendleri* is the more widespread and, apparently, far the commoner. Occasionally, as in the Burro and Organ mountains of New Mexico and the Huachuca and Santa Catalina ranges of Arizona, the two species occur together and have been mixed in collections (see list of specimens cited); but the plants hold their characters well and ordinarily may be distinguished readily by the scales of the under surface, either by the naked eye or using only a low-power lens.

The following specimens of *Cheilanthes Fendleri* are in the National Herbarium.

TEXAS: Eagle Mountain, Nov., 1881, *Havard*; El Paso to Monument 53, Sept., 1892, *Internat. Bound. Comm.* 986 (*Wagner*, coll.).

NEW MEXICO: Burro Mountains, Nov., 1880, *Rusby* I, in greater part; same locality, *Rusby* H 1, in small part; same locality, alt. 2400 meters, *Metcalf* 181; Big Burro Mountains, alt. 2100 meters, *Blumer* 1829; Hillsboro Peak, south end of Black Range, alt. 2700 meters, *Metcalf* 1504; Oak Canyon, Folsom, dry sandstone cliffs, *Howell* 174; San Luis Mountains (on Mexican boundary line), *Mearns* 522, 2191 in part; El Capitan Mountains, Lincoln County, alt. 2100-2250 meters, *F. S. & E. S. Earle* 212; Las Vegas, June 24, 1891, *Dewey*; vicinity of Hot Springs, near Las Vegas, *Rose & Fitch* 17596; bluffs below Winsor's, Pecos National Forest, alt. 2490 meters, *Standley* 4152; Sierra Grande, *Howell* 207; volcanic hills near Sierra Grande, Union County, alt. 2100-2925 meters, *Standley* 6063; vicinity of Ute Park, Colfax County, alt. 2200-2900 meters, *Standley* 13934; Organ Mountains, Dona Ana County, alt. 1650-1800 meters, May 20, 1893, and Aug. 16, 1895, *Wooton*, both in part; same locality, *Wooton* 104, in part; without locality, *Wright* 2126, in part.

ARIZONA: Huachuca Mountains, *Mearns* 2589; north slopes of Huachuca Mountains, July-Oct., 1882, *Lemmon*, in part; near Fort Huachuca, *Wilcox* 54; Dragoon Mountains, March, 1881, *G. R. Vasey*; Rincon Mountains, alt. 2250 meters, *Nealley* 178; Santa Rita Mountains, alt. 1500 meters, May 22, 1884, *Pringle*; San Rita Mountains, July, 1881, *Pringle*; same locality, alt. 1350 meters, *Thornber* 324; Santa Catalina Mountains, March, 1881, *G. R. Vasey*, in greater part; Cherry Creek, Santa Catalina Mountains, alt. 1770 meters, *Shreve* 5113; summit of Gila Mountains, alt. 2040 meters, *Goldman* 2358; Cave Creek, near Portal, Chiricahua National Forest, Cochise County, alt. 1600-1800 meters, *Eggleston* 11014; Barfoot Fire Station, Chiricahua National Forest, Cochise County, alt. 2480 meters, *Eggleston* 10838; Riggs Canyon, Chiricahua Mountains, alt. 1710 meters, *Blumer* 1944; Big Emigrant Canyon, Chiricahua Mountains, alt. 1800-1950 meters, in a granite trough, *Blumer* 1505, 1907; Bowie, *Jones* 4282; Stale Mountain, alt. 2100 meters, *Leiberg* 5570.

COLORADO: Rockwood, alt. 2400 meters, *Tweedy* 600; Manitou, alt.

2100 meters, *F. E. & E. S. Clements* 73.1; mountains near Pikes Peak, Aug., 1871, *ex herb. Canby*; Pike National Forest, *Guthrie* 51G.

4. *Cheilanthes Wootoni* Maxon, sp. nov.

Rhizome epigeal, wide-creeping (5–15 cm.), with a few short branches, slender (about 1.5 mm. in diameter), terete, subflexuous, pale brown, deciduously paleaceous, the scales loosely imbricate, subsecond, mostly oblong-ovate or lance-oblong, acutish to long-acuminate, 2–3 mm. long, 0.7–0.9 mm. broad, straight or falcate, distantly denticulate, pale brown, membranaceous and concolorous, or sometimes bright glossy brown with pale scarioso margins, the middle portion translucent and never strongly sclerotic. Fronds several, erect, distichous, mostly distant (0.5–3 cm. apart), 10–30 cm. long; stipe slender (1 mm. or less in diameter), 5–18 cm. long, subflexuous, castaneous, sublustrous, subpersistently paleaceous, the scales pale, linear-attenuate to filiform, ascending; lamina narrowly oblong to lance-oblong, acuminate, 5–18 cm. long, 2–4.5 cm. broad, tripinnate, the tertiary segments simple to ternately or pinnately divided; rachis similar to the stipe, persistently paleaceous; pinnae usually approximate, mostly alternate, ascending and usually arcuate, short-stalked, subequal in length, narrowly triangular and acuminate or sometimes several lower ones more broadly triangular and strongly inequilateral (broader on the lower side); rachises and whole under surface of the pinnae covered with widely imbricate scales, these extending beyond the margins of the pinnules and completely covering the numerous minute, obovate or rounded-pyriform, close ultimate segments beneath, the segments glabrous above; scales pale castaneous or yellowish brown in mass, nearly concolorous, whitish with age (the cells irregularly elongate, with sinuous partition walls), firmly attached at the sinus of the cordate to subcordate base, narrowly ovate, attenuate to a hair-pointed flexuous or tortuous apex, distantly denticulate, conspicuously long-ciliate in the basal part or beyond, the cilia of the larger scales and of the copiously filamentous, reduced under scales intricate, partly recurved between the segments and loosely overlying the upper surface; sporangia few, large, borne within the rounded, deeply cucullate distal border of the segment, the margin essentially unchanged. Leaf tissue rigidly herbaceous, bright green, minutely papillose, glistening.

Type in the United States National Herbarium, no. 835554, collected in Madero Canyon, Santa Rita Mountains, Arizona, September 21, 1914, by E. O. Wooton.

As noted elsewhere this species has hitherto been strangely confused with *C. Fendleri*, an unusual width of variation being ascribed to the latter species, notwithstanding that the distinguishing characters of the two plants hold without exception and are rather easily made out. In general, *C. Wootoni* is much more copiously scaly beneath than *C. Fendleri*, the scales being much slenderer, with long, flexuous, hair-pointed tips, and having numerous cilia, at least in the basal part; the scales of *C. Fendleri* are at most long-attenuate and are invariably non-ciliate. In *C. Wootoni*, moreover, the cilia of the larger scales and, more

especially, the filamentous tips of the reduced under ones are more or less intricately recurved among the segments and reach the upper surface of the pinnae, there freely overlying the ultimate rachises and segments—a condition which scarcely exists in *C. Fendleri* from the paucity of reduced scales and the absence of cilia upon the large ones. In general cell structure the scales of the two species are similar, but the characters above mentioned, together with the characteristic scanty aspect of *C. Fendleri*, with its more richly colored, concave scales, are unmistakable. The occasional occurrence together of these two closely related species is comparable to the case of *Pellaea Wrightiana* and *P. longimucronata*, recently discussed,* and is not in itself remarkable. Differences in scale structure, if fixed, are the very characters upon which dependence is to be placed, in xerophilous fern genera such as *Cheilanthes*, and there is in the present instance no indication whatever of intergradation.

The following additional specimens of *Cheilanthes Wootoni* are in the National Herbarium.

ARIZONA: North slopes of Huachuca Mountains, July-Oct., 1882, *Lemon*, in part; Santa Rita Mountains, May 27, 1881, *Pringle*; Coronado Mountains, alt. 1950 meters, *Goldman* 2370; Lower Soldier Canyon, Santa Catalina Mountains, alt. 1320 meters, *Shreve* 5117; Santa Catalina Mountains, March, 1881, *G. R. Vasey*, in small part; head of Rincon Valley, Rincon Mountains, *Blumer* 3291; Nogales, *W. Palmer* 1202; Bowie, *Jones* 4268; Lowell, *W. F. Parish* 275; Clear Creek, *MacDougal* 629; without locality, *E. Palmer*.

NEW MEXICO: Organ Mountains, Dona Ana County, alt. 1650-1800 meters, May 20, 1893, Aug. 6, 1895, and Nov., 1905, *Wooton*, the two first in part; same locality, July 7, 1897, *Wooton* 104, in part; same locality, June 9, 1906, *Standley*; Santa Fe, *Rothrock* 52; Burro Mountains, *Rusby* I, in small part; same locality, *Rusby* H 1, in greater part; without locality, *Wright* 2126, in part.

5. *Cheilanthes Covillei* Maxon, sp. nov.

Rhizome short-creeping and freely branched, the very numerous short divisions usually close and intricate, 2-4 mm. in diameter, very densely paleaceous, the scales appressed, closely imbricate, linear to lanceolate, long-attenuate, 1.5-2.5 mm. long, 0.2-0.5 mm. broad, straight, more or less denticulate-serrulate at the tip, dark brown or blackish, rigid, strongly sclerotic and opaque throughout, except for the extremely narrow, delicate, pale border. Fronds numerous, erect, closely distichous, 10-30 cm. long; stipe slender to stoutish (0.6-1.3 mm. in diameter), 5-17 cm. long, straight or subflexuous from an arcuate base, brown to dark purplish, sublustrous, thinly and deciduously paleaceous, the scales small, pale, linear-attenuate, laxly ascending; lamina oblong to ovate-deltoid or deltoid, acuminate, 5-14 cm. long, 2-6 cm. broad at or near the base, tripinnate, the larger tertiary segments ternately to pinnately divided, the divisions commonly unequal; rachis similar to the stipe, but more densely paleaceous; larger pinnae 8-12 pairs, mostly contiguous or

* Proc. Biol. Soc. Washington, 30 : 179-184. 1917.

approximate (the lowermost 1 or 2 pairs farther apart), ascending, often falcate and somewhat involute in drying, narrowly deltoid, or the short-stalked lower ones rather broadly deltoid and strongly inequilateral (broader on the lower side); rachises and whole lower surfaces of the pinnae densely paleaceous, the scales widely imbricate, extending beyond the margin of the pinnules and entirely concealing the thick, roundish or irregularly oval ultimate segments beneath, the segments glabrous above; scales pale castaneous with lighter borders and tips, or sometimes whitish with a dark center, large, variable in outline (varying from exactly cordate and acute to deltoid-cordate and acuminate or ovate-lanceolate and long-acuminate or attenuate), lightly attached above the closed sinus of the very deeply cordate base (the lobes overlapping), long-ciliate at the base or upward to the middle, erose-denticulate toward the apex, the cells irregular, with deeply sinuous partition walls; rachises of the pinnae bearing few or numerous slender pale scales above and at the sides, these recurved upon the upper side of the segments, together with the tips and long cilia of some of the large under scales; sporangia rather numerous, borne within the deeply recurved semicircular border of the distal half or two-thirds of the segment, the margin lightly crenate, nearly unmodified. Leaf tissue dull to yellowish green, herbaceous, minutely papillose.

Type in the United States National Herbarium, no. 51039, collected in Surprise Canyon, Panamint Mountains, Inyo County, California, altitude 1550 meters, April 13, 1891, by Frederick V. Coville and Frederick Funston (no. 593), on the Death Valley Expedition of the United States Department of Agriculture.

As stated above, the correctness of referring this plant of southern California and near-by territory to *C. myriophylla* has been repeatedly questioned. Eaton, acting apparently at the suggestion of his contributing correspondent, William Stout, at one time separated it in the herbarium as a new species and gave it a manuscript name, according to Mr. C. A. Weatherby, who has examined the Eaton material at New Haven. This disposition was entirely correct, notwithstanding the broad variation it exhibits in shape, color, and ciliation of lamina scales. In relation to *C. Fendleri* and *C. Wootoni* its most notable characters are the rigid, thick, blackish or dark brown rhizome scales and the very deeply cordate bases of the lamina scales, the latter so delicately attached above the closed sinus as to rotate at touch and to be readily detached from the lamina. The characters which distinguish it from other related species and from a peculiar form described below as *C. Covillei intertexta* are indicated in the key.

The following additional specimens of *Cheilanthes Covillei* are in the National Herbarium.

CALIFORNIA: Hills west of Big Pine, Inyo County, Heller 8261; Surprise Canyon, Panamint Mountains, Inyo County, alt. 1625 meters, Coville & Funston 643; same locality, alt. 1560 meters, Coville & Funton 651; Slate Range, Inyo County, alt. 1150 meters, Coville & Funston 188; near Willow Creek, Panamint Mountains, Inyo County, alt. 1950-2300 meters, Coville & Funston 777; east slope of the Panamint Mountains,

one mile north of Panamint Pass, alt. 2560 meters, *Coville & Funston* 540; Lone Pine, Inyo County, alt. 2100 meters, May 14, 1897, *Jones*; Tehachapi, Kern County, March 14, 1913, *Wooton*; Topatopa Mountains, Ventura County, alt. 1950 meters, *Abrams & McGregor* 88; Pasadena, *Jones* 3033; near summit of Mount Washburn, San Gabriel Mountains, Los Angeles County, *Moxley* 419; trail to Barley Flats, San Gabriel Mountains, alt. 1500 meters, *Moxley* 399; Laguna, Orange County, *Internat. Bound. Comm.* 3608 (*Schoenfeldt*, coll.); Whitewater, *G. R. Vasey* 13; several localities in the San Antonio Mountains, alt. 900–2250 meters, *Johnston* 86, 1594, 1729, 1739; Palm Canyon, Riverside County, alt. 750 meters, *Johnston* 1113; Riverside County, in dry, rocky, open situations, *Grant* 220; near Hemet Lake, San Jacinto Mountains, alt. 1340 meters, *Leiberg* 3155; San Jacinto Canyon, Riverside County, alt. 675 meters, *Johnston* 1830; Santa Ysabel, San Diego County, *Henshaw* 41; southwestern part of the Colorado Desert, San Diego County, *Orcutt* 2188; Warner's Hot Springs, *Eastwood* 2615; Jacumba Hot Springs, San Diego County, near Monument 233, *Internat. Bound. Comm.* 3232 (*Schoenfeldt*, coll.); San Diego County, *G. R. Vasey* 690; Mill Creek Falls, San Bernardino County, *S. B. Parish* 5073; San Bernardino Mountains, among rocks, *S. B. & W. F. Parish* 509; "southern California," *Parry & Lemmon* 425; White Cliff Creek, *Bigelow*; small butte about 5 miles north of Grizzly Flats, Eldorado County, alt. 1500 meters, *Watkins* 1; Yosemite Falls, alt. 1290 meters, *Watkins* 2.

NEVADA: Virgin River, Bunkerville, rock crevices in canyons, *Goodding* 736.

ARIZONA: Hills 4 miles northwest of Congress Junction, Yavapai County, alt. 750–900 meters, Feb. 17, 1912, *Wooton*; Salt River, 12 miles north of McMillinville, alt. 840 meters, *Goldman* 2670; "northern Arizona," 1869, *E. Palmer*.

LOWER CALIFORNIA: Mountains, Los Angeles Bay, 1887, *E. Palmer* 553; locality wanting, "rocky places," April, 1882, *Pringle*; "northern Lower California," Sept. 8, 1884, *Orcutt*.

5a. *Cheilanthes Covillei intertexta* Maxon, subsp. nov.

Similar in general characters to *C. Covillei*, but differing in its smaller, shorter-creeping, subnodose rhizomes, its darker green and relatively larger lamina segments, and conspicuously in the vestiture of the lamina; segments bearing one to several greatly reduced, whitish, stellate, subpersistent scales above, thickly clothed beneath with several to numerous, bright castaneous to cinnamomeous, imbricate scales, these highly variable in size and ciliation, the larger ones (like those of the secondary and tertiary rachises) mostly deltoid-lanceolate, long-attenuate, sinuate-denticulate nearly throughout, freely long-ciliate at the cordate base, these scales underlaid by others successively smaller and more copiously ciliate, the ultimate ones very greatly reduced (body of scales nearly obsolete), entangled and not separable, forming a loose tomentum held in place by the crenulate, widely revolute border of the segment.

Type in the Dudley Herbarium, Leland Stanford Junior University,

no. 63946, collected at the top of Black Mountain, Santa Cruz Mountains, Santa Clara County, California, July 6, 1903, by W. R. Dudley.

The following additional specimens are at hand:*

CALIFORNIA: West end of Loma Prieta Peak, Santa Cruz Mountains, Nov. 1, 1903, *Dudley* (S); Mount Day in the Mount Hamilton Range, Santa Clara County, altitude 1170 meters, Apr. 29, 1908, *Heller*; same locality, "May 23," *R. J. Smith* (S); bank of Mill Creek, Ukiah, Mendocino County, 1866, *Bolander* 4640; Hood's Peak, Sonoma County, March, 1893, *Michener & Bioletti*.

NEVADA: Virginia City, *Bloomer*.

The characters above indicated would seem sufficient for the separation of this form as specifically distinct, were it not for additional specimens from Hood's Peak (collected by Bioletti in 1892, and by Michener and Bioletti in May, 1893), which, though lacking reduced stellate scales on the upper side of the segments, seem to show in the scaly covering of the under side of the lamina a transition to the broad form of scales characteristic of true *C. Covillei*, in which a single large scale will completely cover one or several minute segments. The distinctive scale characters are doubtless correlated with conditions of habitat and climate not surrounding the more southerly plant, but they suggest the desirability of further study of this form with the help to be gained from more complete material. In abundance and high color of reduced scales beneath there is a considerable resemblance to *C. Clevelandii*, and it is otherwise evident that *C. Clevelandii*, *C. Covillei*, and *C. Covillei intertexta* are of common origin.

6. *Cheilanthes Clevelandii* D. C. Eaton, Bull. Torrey Club 6: 33. 1875.

Rhizome creeping, epigeal, ligneous, relatively slender (2-3.5 mm. in diameter), flexuous, with a few short branches, coarsely radiceous beneath, densely and persistently paleaceous, the scales imbricate, closely appressed, subulate to lance-attenuate, ending in a fragile filiform tip, 2.5-3 mm. long, about 0.5 mm. broad, bright to dark brown, glossy, the median portion moderately sclerotic or strongly so toward the apex, the paler borders semitranslucent, subentire. Fronds several, erect, distichous, 1 cm. or less apart, obliquely attached, 15-50 cm. long; stipe 7-24 cm. long, stout (1.2-2 mm. in diameter), light brown, often broadly flexuous, thinly and deciduously paleaceous, the scales minute, very slender, pale; lamina linear-lanceolate to ovate or deltoid-oblong, acuminate, 7-26 cm. long, 2.5-8 cm. broad, tripinnate or nearly quadripinnate; rachis similar to the stipe but persistently paleaceous, the scales darker; pinnae numerous, mostly alternate and contiguous, ascending, often strongly so, falcate, narrowly deltoid to deltoid-oblong, or the lower ones sometimes exactly deltoid; secondary and tertiary rachises and the midribs of the segments copiously appressed-paleaceous beneath, the scales small, imbricate, closely investing and wholly concealing the segments, bright to dark castaneous at maturity, deltoid-ovate, attached above the closed sinus of the deeply cordate base, abruptly long-acuminate and attenuate, conspicuously erose-dentate, the teeth long-ciliate,

*The specimens indicated by (S) are in the Dudley Herbarium.

the numerous cilia of the reduced under scales closely entangled; cells of the scales irregular, with deeply sinuous partition walls; tertiary segments simple to ternately divided or sometimes fully pinnate; ultimate segments in general very small, flattish, close, sessile, subcordate-orbicular (the terminal ones larger and relatively longer), above glabrous, but with the recurved cilia of some of the large dorsal scales and the slender divisions of reduced filamentous scales of the upper side of the rachises lying among and partly over them; sporangia rather numerous, borne partly within the narrowly revolute border of the segments nearly throughout, the margin crenulate, nearly unchanged. Leaf tissue rigidly spongiöse-herbaceous, dull green.

This species was described originally from specimens collected "on a mountain about forty miles from San Diego, California," at an elevation of about 750 meters, by Daniel Cleveland, in 1874. Its range is stated by Parish* as "mountains of San Diego County [California], north to Beaumont, Riverside County, and south into Lower California." The numerous specimens in the National Herbarium are all from San Diego and Riverside counties with the exception of the following, these apparently extending the accepted range of the species: Bartlett's Canal, Santa Barbara, California, 1875, *Rothrock* 60, labelled by Davenport "a large form of *C. gracillima*;" Santa Cruz Island, California, August, 1893, *Yates*; same locality, July 17, 1917, *Eastwood* 6399.

Although occasional specimens of the common California plant here called *C. Covillei* have been determined as *C. Clevelandii*, true *C. Clevelandii* has rarely been misidentified. In its large size, slender, woody, appressed-paleaceous, creeping rhizome, stout, light brown stipes, spaced pinnules, and general scanty aspect it is well marked, as also in the subcordate form of its pinnules and their dense covering of closely appressed, small, deltoid-ovate, richly colored scales. It is more copiously fertile than most related species, the sporangia less concealed and extending almost to the extreme base of the segments. Its nearest ally, apparently, is *C. Covillei*.

* Fern Bull. 12: 7. 1904.